

ACALYPTRATE DIPTERA ASSOCIATED WITH STANDS OF *CAREX*
LACUSTRIS AND *C. STRICTA* (CYPERACEAE) IN NORTHEASTERN OHIO

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Abstract.—Eighty-seven species of acalyptrate Diptera were swept from stands of the sedges *Carex lacustris* and *C. stricta* in a small freshwater marsh located near the city of Kent in Portage County in northeastern Ohio. Information is presented on stand preference, seasonal distribution, and larval feeding habits for the 45 species for which more than one specimen was collected. The most species-rich families were Chloropidae (28 spp.), Ephydriidae (15), and Sciomyzidae (14).

Key Words: freshwater marsh, *Carex*, acalyptrate Diptera, Ohio, larval feeding habits

There seems to be a general impression among wetland biologists that higher flies are relatively unimportant in marshes, probably because many of the species of marsh-inhabiting cyclorrhaphous Diptera are not truly aquatic and thus are not thought to be involved in aquatic food chains leading to fish or waterfowl production (Keiper et al. 2002). However, species richness of Diptera can be high (Todd and Foote 1987a, Beaulieu and Wheeler 2002), and populations of certain species can be huge in freshwater wetlands (Larson and Foote 1997, Keiper and Walton 2000). Because of their abundance, species richness, and diversity of feeding habits, acalyptrate flies undoubtedly play important roles in marshland ecology, and probably are particularly important as food resources for small birds and mammals (King and Brazner 1999).

This is the eighth paper in a series of publications focusing on the acalyptrate Diptera of freshwater marshes in northeastern Ohio (Todd and Foote 1987a, b; Rogers et al. 1991; Wearsch and Foote 1994; Keiper et al. 1998; Larson and Foote 1997; Foote, in press). The present study gives survey data obtained during one warm sea-

son of collecting acalyptrate Diptera in stands of two sedge species, *Carex lacustris* Wild. and *C. stricta* Lam., in a small marsh located in northeastern Ohio. Information is given on stand preference, seasonal occurrence, and larval feeding habits of 45 of the 87 associated species.

MATERIALS AND METHODS

The freshwater marsh, “Horning Road Marsh,” utilized in this study is located 0.8 km east of the main campus of Kent State University (Portage Co.). It encompasses some 0.5 h and supports a mosaic of eight vegetation types occurring in nearly monocultural stands (Todd and Foote 1987a). *Carex lacustris* is a cespitose, rhizomatous, broad-leaved (8–15 mm) species that forms a nearly closed canopy over the marsh muds. In contrast, *C. stricta* is a narrow-leaved (2–5 mm) clumped sedge, a growth form that allows considerable light to reach the marsh surface.

Acalyptrate Diptera were obtained by sweep samples consisting of 15 back and forth movements of a standard aerial insect net through the vegetation. Sampling took

place weekly for 22 weeks between May 6 and September 29, 1989.

RESULTS AND DISCUSSION

A total of 93 species of acalyptrate Diptera was obtained in the two stands of *Carex* (Table 1). Sixty-four species were found in *C. lacustris*, and 74 in *C. stricta*. In the list below, 48 species are covered in greater detail with respect to their occurrences in the two stands, relative abundances, and larval feeding habits.

ANNOTATED LIST OF SELECTED SPECIES

Family Agromyzidae

Cerodontha (*Cerodontha*) *dorsalis* (Loew).—Adults of this species were more abundant in *C. lacustris*, being recorded from mid-May to mid-August. It appeared to be bivoltine, as no adults were recorded between late June and late August. The larvae are leaf miners of grasses (Spencer and Steyskal 1986). Grasses were intermixed with *C. lacustris* in this stand.

Cerodontha (*Butomomyza*) *subangulata* (Malloch).—Larvae are known to mine leaves of *Carex* (Spencer and Steyskal 1986).

Family Anthomyzidae

Anthomyza *variegata* (Loew).—Six individuals were swept from *C. lacustris*. Larvae of this stem-boring species overwinter in culms of the host plant.

Mumetopia *occipitalis* Melander.—Seven specimens were taken in *C. lacustris*, and 11 in *C. stricta*. The larvae are reported to mine the stems of wetland monocots (Ferrari 1987).

Family Chamaemyiidae

Plunomia *elegans* Curran, *P. tibialis* Malloch, *P. transversa* Malloch.—Thirty-five adults of these three species were taken from *C. stricta* during late May and early June. Nothing is known of the larval feeding habits of any of these species, but other species of the family prey on aphids and scale insects (Sluss and Foote 1971, 1973).

Family Chloropidae

Chlorops certima Adams.—This was an abundant species between late May and mid-June in *C. lacustris*. Larvae are stem borers of several *Carex* species (Rogers et al. 1991). They reported that there is a single annual generation, with overwintering occurring as third-instar larvae in dead culms.

Conioscinella nuda (Adams).—This was a common species in both species of *Carex*, where its larvae fed as secondary invaders of stems damaged by phytophagous larvae of the dipterous family Scathophagidae.

Dasyopa sp.—One adult of this apparently new species was taken in each *Carex* stand. Nothing is known of the life history or larval feeding habits of any species of the genus.

Elachiptera erythropleura Sabrosky.—Taken only in *C. stricta*, the larvae of this species are secondary invaders of monocot stems damaged by other insect larvae (Valley et al. 1969).

Elachiptera nigriceps (Loew).—This was an abundant species in both species of *Carex*. Its larvae feed as secondary invaders of stems damaged by phytophagous larvae (Valley et al. 1969).

Epichlorops exilis (Coquillett).—This was an abundant species between late May and early July in *C. lacustris* (Fig. 2), where its larvae were stem miners (Rogers et al. 1991).

Eriholus longulus (Loew).—A common species in wetlands, adults were abundant throughout the warm season in both sedge stands. Its larvae are secondary invaders of the stems of wetland monocots that have been damaged by phytophagous larvae (Valley and Foote 1996).

Incertella bispina (Malloch).—Adults were taken only in *C. lacustris*. Its larval feeding habits are unknown.

Incertella incerta (Becker).—This was an abundant species in both species of *Carex*. Its larvae fed as secondary invaders of stems of monocots.

Table 1. Species, numbers, and trophic guilds of acalyptrate Diptera collected in stands of *Carex lacustris* and *C. stricta* in northeastern Ohio.

Species	Number Collected in		Trophic Guild
	<i>Carex lacustris</i>	<i>Carex stricta</i>	
AGROMYZIDAE			
<i>Agromyza albipennis</i> Meigen	1	0	Leaf miner
<i>Amauromyza</i> sp.	0	1	Leaf miner
<i>Cerodontha dorsalis</i> (Loew)	5	1	Leaf miner
<i>Cerodontha magnicornis</i> (Loew)	1	0	Leaf miner
<i>Cerodontha subangulata</i> (Malloch)	1	0	Leaf miner
<i>Metopomyza interfrontalis</i> (Melander)	2	0	Leaf miner
ANTHOMYZIDAE			
<i>Anthomyza variegata</i> (Loew)	0	2	Stem borer
<i>Mumetopia occipitalis</i> Melander	7	11	Stem borer
Undetermined sp.	0	4	Unknown
AULACIGASTRIDAE			
<i>Cyamops halteratus</i> Sabrosky	0	1	Unknown
CHAMAEMYIIDAE			
<i>Chamaemyia juncorum</i> (Fallén)	0	1	Scale predator
<i>Plunomia elegans</i> Curran	0	29	Unknown
<i>Plunomia tibialis</i> Malloch	0	4	Unknown
<i>Plunomia transversa</i> Malloch	4	1	Unknown
CHLOROPIDAE			
<i>Apallates neocoxendix</i> (Sabrosky)	0	1	Unknown
<i>Aphanotrigonum scabra</i> (Aldrich)	0	4	Unknown
<i>Chlorops certima</i> Adams	2	4	Stem borer
<i>Chlorops sulphurea</i> Loew	1	0	Stem borer
<i>Conioscinella flavescens</i> (Tucker)	0	1	Secondary invader
<i>Conioscinella nuda</i> (Adams)	14	5	Secondary invader
<i>Dasyopa</i> sp.	1	1	Unknown
<i>Elachiptera costata</i> (Loew)	1	1	Secondary invader
<i>Elachiptera erythropleura</i> Sabrosky	0	3	Secondary invader
<i>Elachiptera nigriceps</i> (Loew)	33	48	Secondary invader
<i>Elachiptera penita</i> (Adams)	3	1	Unknown
<i>Epichlorops exilis</i> (Coquillett)	163	4	Stem borer
<i>Eribohus longulus</i> (Loew)	60	84	Secondary invader
<i>Eribohus nana</i> (Zetterstedt)	1	0	Secondary invader
<i>Incertella bispina</i> (Malloch)	9	0	Unknown
<i>Incertella incerta</i> (Becker)	148	61	Secondary invader
<i>Incertella infesta</i> (Becker)	2	2	Secondary invader
<i>Incertella</i> sp. (new?)	2	0	Unknown
<i>Liohippelates pallipes</i> (Loew)	8	14	Unknown
<i>Meromyza americana</i> Fitch	4	0	Stem borer
<i>Olcella trigramma</i> (Loew)	1	0	Unknown
<i>Oscinella frit</i> (Linnaeus)	98	44	Stem borer
<i>Pseudopachychaeta approximatinervis</i> (Zett.)	2	2	Seed predator
<i>Rhopalopterum carbonaria</i> (Loew)	156	112	Secondary invader
<i>Rhopalopterum soror</i> (Macquart)	1	0	Scavenger
<i>Rhopalopterum umbrosa</i> (Loew)	2	4	Unknown
<i>Stenoscinis atriceps</i> (Loew)	1	6	Secondary invader
<i>Thaumatomyia glabra</i> (Meigen)	3	8	Aphid predator
DIASTATIDAE			
<i>Diastata repleta</i> (Walker)	0	1	Scavenger

Table 1. Continued.

Species	Number Collected in		Trophic Guild
	<i>Carex lacustris</i>	<i>Carex stricta</i>	
DROSOPHILIDAE			
<i>Drosophila palustris</i> Spencer	0	2	Scavenger
<i>Drosophila quinaria</i> Loew	0	1	Scavenger
<i>Scaptomyza adusta</i> (Loew)	2	5	Scavenger
<i>Scaptomyza pallida</i> (Zetterstedt)	81	455	Scavenger
EPHYDRIDAE			
<i>Coenia curvicauda</i> (Meigen)	4	2	Scavenger, phycovore
<i>Discocerina obscurella</i> (Fallén)	1	2	Scavenger, phycovore
<i>Hyadina albovenosa</i> Coquillett	1	3	Phycovore
<i>Hydrellia griseola</i> (Fallén)	2	3	Leaf miner
<i>Lytogaster excavata</i> (Sturtevant and Wheeler)	2	7	Phycovore
<i>Microlytogaster extera</i> (Cresson)	1	1	Phycovore
<i>Nostima picta</i> (Fallén)	1	5	Phycovore
<i>Notiphila caudata</i> (Fallén)	18	19	Scavenger, phycovore
<i>Notiphila solita</i> Walker	1	1	Scavenger
<i>Ochthera anatolikos</i> Clausen	0	1	Insect predator
<i>Pelina truncatula</i> Loew	0	1	Phycovore
<i>Philotelma alaskensis</i> Cresson	1	1	Phycovore
<i>Philygria debilis</i> Loew	0	1	Phycovore
<i>Scatella picea</i> (Walker)	1	0	Scavenger, phycovore
<i>Scatella stagnalis</i> (Fallén)	0	8	Scavenger, phycovore
LAUXANIIDAE			
<i>Camptoprosopella</i> sp.	0	1	Unknown
<i>Minettia lupulina</i> (Fabricius)	0	1	Scavenger
MICROPEZIDAE			
<i>Compsobata pallipes</i> (Say)	0	11	Scavenger
OPOMYZIDAE			
<i>Opomyza petrei</i> Mesnil	0	2	Stem borer
SCIOMYZIDAE			
<i>Atrichomelina pubera</i> (Loew)	2	1	Snail predator
<i>Dictya expansa</i> Steyskal	7	8	Snail predator
<i>Dictya steyskali</i> Valley	4	1	Snail predator
<i>Elgiva sollicita</i> (Harris)	28	29	Snail predator
<i>Pherbellia nana</i> (Fallén)	12	0	Snail predator
<i>Pteromicra pleuralis</i> (Cresson)	7	4	Snail predator
<i>Sepedon armipes</i> Loew	1	0	Snail predator
<i>Sepedon borealis</i> Steyskal	4	0	Snail predator
<i>Sepedon fuscipennis</i> Loew	22	5	Snail predator
<i>Sepedon tenuicornis</i> Cresson	168	44	Snail predator
<i>Tetanocera ferruginea</i> Fallén	7	3	Snail predator
<i>Tetanocera fuscinervis</i> (Zetterstedt)	1	0	Snail predator
<i>Tetanocera loewi</i> Steyskal	2	1	Snail predator
<i>Tetanocera plumosa</i> Loew	0	1	Snail predator
SEPSIDAE			
<i>Enicita annulipes</i> (Meigen)	0	2	Scavenger
<i>Enicomira minor</i> (Haliday)	0	3	Scavenger
<i>Sepsis flavimana</i> Meigen	0	12	Scavenger

Table 1. Continued.

Species	Number Collected in		Trophic Guild
	<i>Carex lacustris</i>	<i>Carex stricta</i>	
SPHAEROCERIDAE			
<i>Coproica urbana</i>	1	0	Scavenger
<i>Leptocera fontinalis</i> (Fallén)	11	178	Scavenger
<i>Limosina</i> sp.	0	2	Scavenger
<i>Rachispoda richardsi</i> Sabrosky	0	2	Scavenger
<i>Rachispoda spuleri</i> Sabrosky	0	1	Scavenger
<i>Trachyopella nuda</i> Rohacek and Marshall	1	0	Scavenger
TEPHRITIDAE			
<i>Euaresta bella</i> (Loew)	1	0	Seed predator
<i>Euaresta festiva</i> (Loew)	2	0	Seed predator
ULIDIIDAE			
<i>Chaetopsis aenea</i> (Wiedemann)	159	41	Scavenger
<i>Chaetopsis massyla</i> (Walker)	161	15	Scavenger
Number of species:	64	74	
Number of individuals	1,454	1,352	

Lihippelates pallipes (Loew).—This was a fairly common species in both species of *Carex*. Its larval feeding habits are unknown.

Oscinella frit (Linnaeus).—Adults were collected in both species of sedge, although they were far more abundant in an adjacent stand of reed canary grass, *Phalaris arun-*

dinacea L. Larvae are stem borers of a great variety of grasses (Ferrar 1987).

Pseudopachychaeta approximatinervis (Zetterstedt).—Only two adults were taken in each species of *Carex*. The larvae are seed predators of spike-rush, *Eleocharis smallii* (Valley et al. 1969), and other species of sedges.

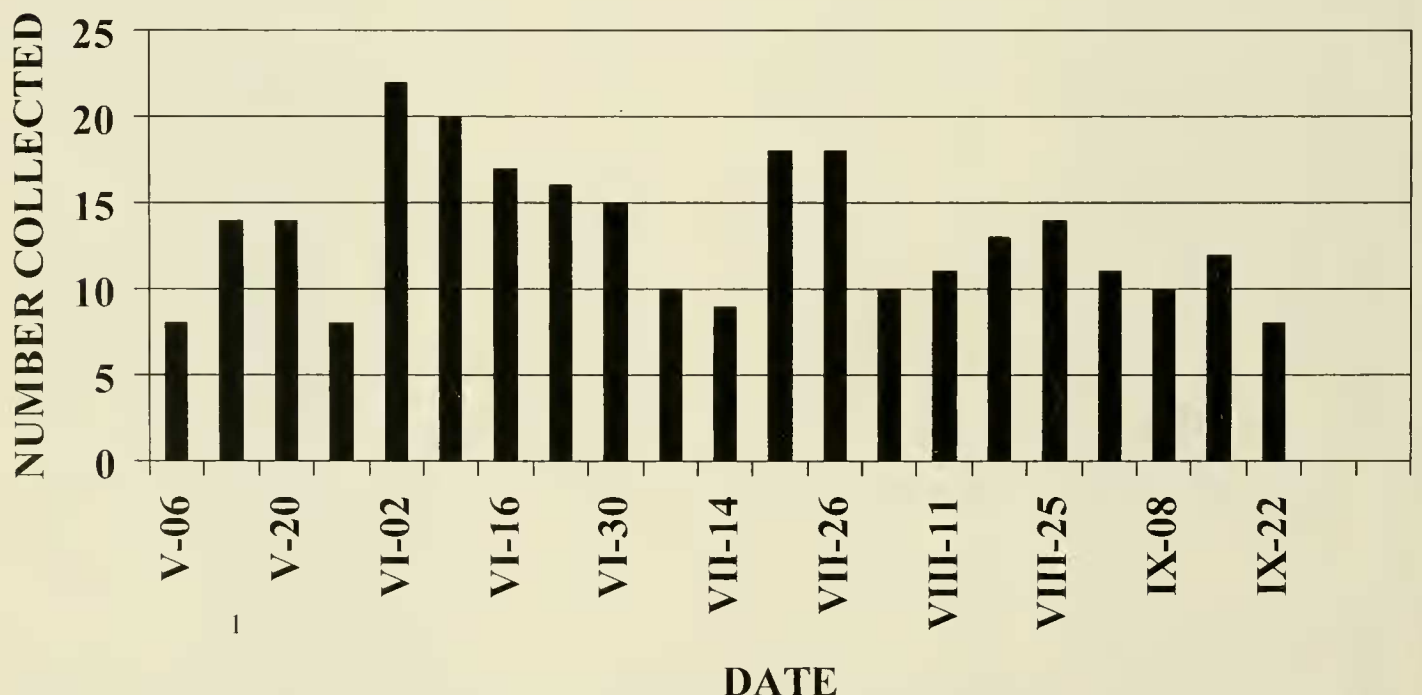


Fig. 1. Seasonal occurrence of species of acalyptrate Diptera in *Carex lacustris*.

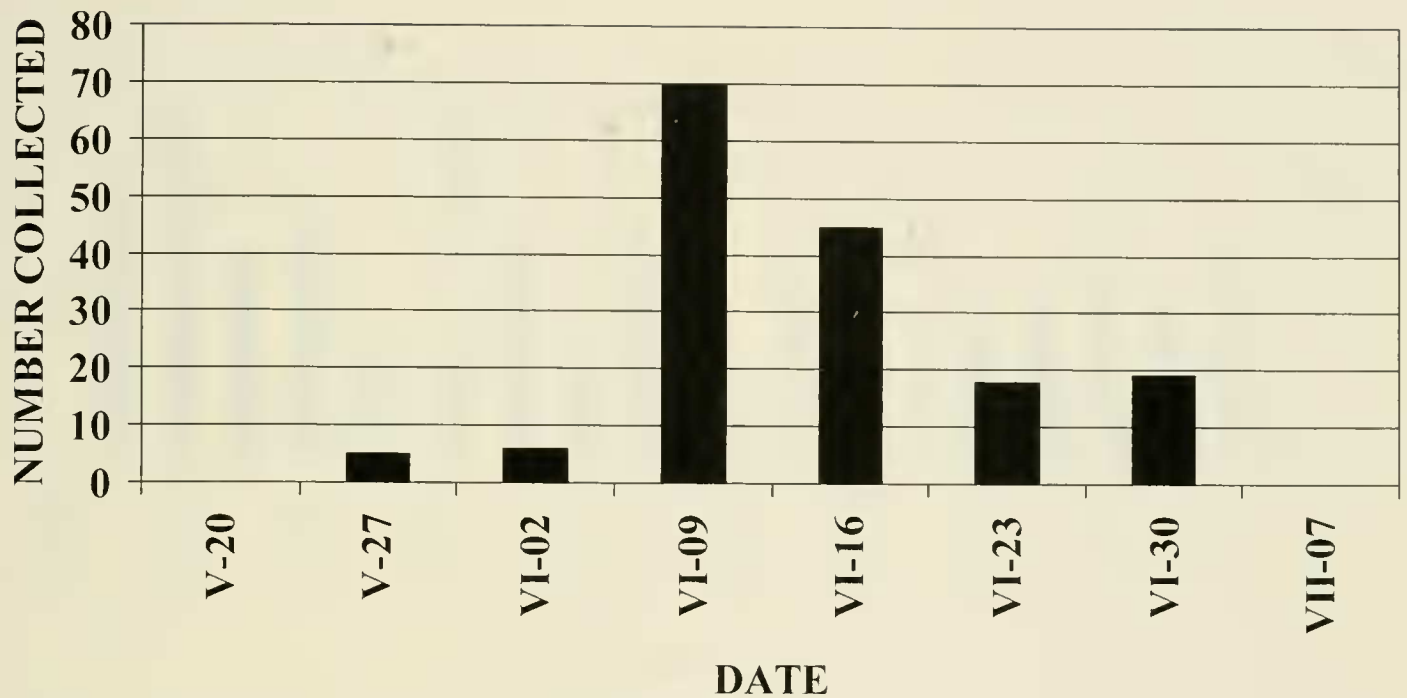


Fig. 2. Seasonal occurrence of *Epichlorops exilis* in *Carex lacustris*.

Rhopalopterum carbonaria (Loew).—This was an abundant taxon in both species of *Carex*. Its larvae are secondary invaders of stems previously damaged by phytophagous insect larvae (Valley et al. 1969).

Thaumatomyia glabra (Meigen).—Three adults of this species were taken in *C. lacustris*, whereas eight were swept from *C. stricta*. Larvae are predators of root-inhabiting aphids (Parker 1918).

Family Drosophilidae

Drosophila palustris Spencer.—Taken only in *C. lacustris*, adults of this marsh-inhabiting species were reared from larvae found in moist, decaying leaves and stems of various species of sedges.

Drosophila quinaria Loew.—This is another species of *Drosophila* commonly found in freshwater marshes, although I collected only one specimen. Its larvae feed on decaying plant material.

Scaptomyza pallida (Zetterstedt).—This was an abundant species throughout the collecting season, with greatest numbers being obtained in *C. stricta*. Its larvae are general scavengers of decaying plant material (Ferrari 1987).

Ephydriidae

Coenia curvicauda (Meigen).—Usually this is a fairly common species in marshes, but I obtained only six specimens, mostly from *C. lacustris*. The larvae are generalized feeders on organic particulate matter, including algae and decaying plant material (Foote 1990).

Discocerina obscurella (Fallén).—Only three specimens of this normally common and widely distributed species were found in the stands of *Carex*. Its larvae are generalized feeders of particulate organic matter (Foote and Eastin 1974).

Hyadina albovenosa Coquillett.—Uncommon in both stands, larvae of this species feed on Cyanobacteria (Foote 1993).

Hydrellia griseola (Fallén).—Uncommon in the sedge stands, larvae of this species feed as leaf miners on a great variety of grasses and other wetland monocots (Deonier 1971, 1978).

Lytogaster excavata (Sturtevant and Wheeler).—Fairly common in the stand of *C. stricta*, larvae of this species consume Cyanobacteria, particularly species of soil-inhabiting *Cylindrospermum* (Foote 1981a).

Nostima picta (Fallén).—Larvae of this

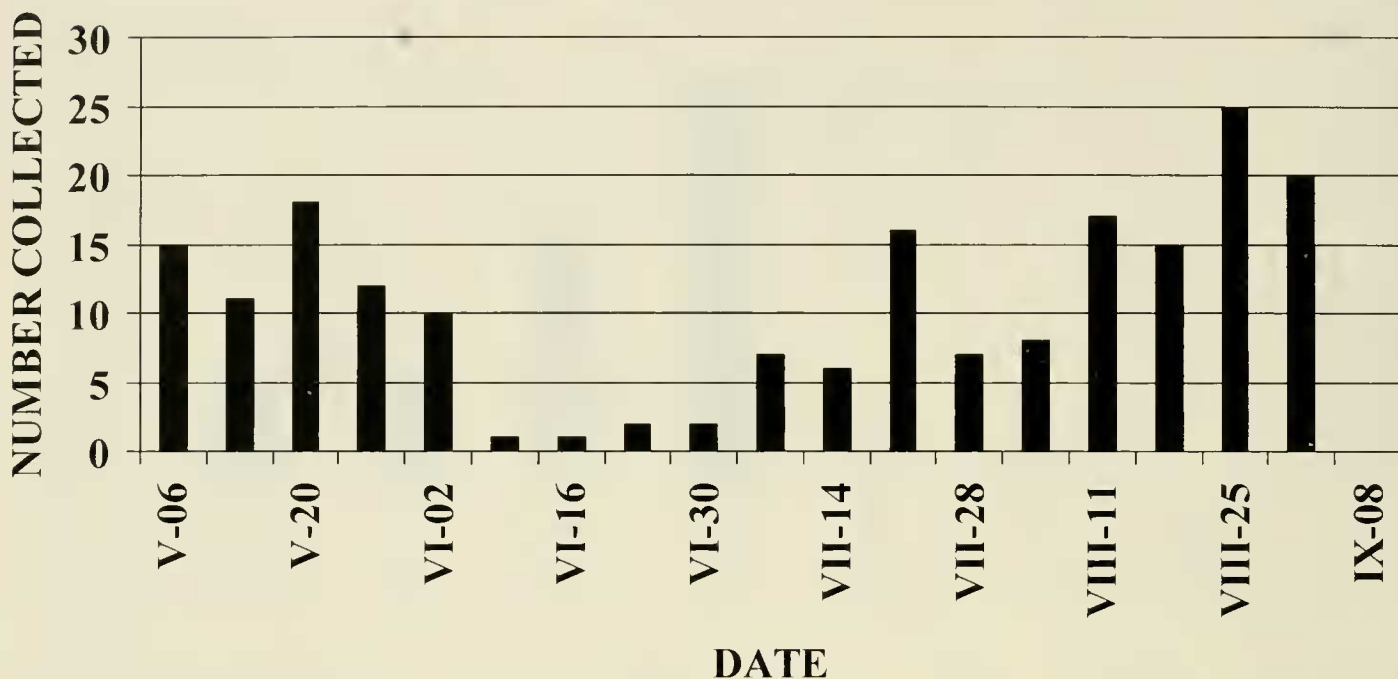


Fig. 3. Seasonal occurrence of *Sepedon tenuicornis* in *Carex lacustris*.

species are specialized consumers of the cyanobacterial genus *Oscillatoria* (Foote 1983).

Notiphila caudata Fallén.—This was an abundant species in both stands. Its larvae feed on particulate organic matter, including algal cells, on the surface of marsh soils (Eastin and Foote 1971).

Pelina truncatula Loew.—An uncommon species in sedge marshes, this species is more regularly taken in stands of cattail (*Typha* spp.). Its larvae feed on such cyanobacterial genera as *Anabaena* and *Cylindropsernum* (Foote 1981b).

Philygria debilis Loew.—Only one specimen of this small, inconspicuous species was found in *C. stricta*. Adults are more commonly encountered in marshes and moist meadows dominated by grasses. Larvae feed on the cyanobacterial genus *Oscillatoria* (Foote 1983).

Family Micropezidae

Compsobata pallipes (Say).—Eleven specimens were swept from *C. stricta*. Larvae of a closely related species have been reared from decaying plant material (Teskey 1972).

Family Sciomyzidae

Dictya expansa Steyskal, *D. steyskali* Valley.—Adults of both species were taken in both sedges throughout the summer months. Larvae prey on aquatic pulmonate snails (Valley and Berg 1977).

Elgiva sollicita (Harris).—A common species in both sedges throughout the warm season, this species has the interesting habit of overwintering as adults in marshes. Its larvae prey unselectively on aquatic pulmonate snails (Knutson and Berg 1964).

Pherbellia nana nana (Fallén).—Adults were found in *C. lacustris* throughout the spring and summer months. Larvae of this species attack a great variety of small pulmonate aquatic snails that have been stranded by dropping water levels (Bratt et al. 1969).

Sepedon borealis Steyskal, *S. fuscipennis* Loew, *S. tenuicornis* Cresson.—All three species of *Sepedon* were encountered repeatedly in both sedge stands. Adults overwinter in marshes where their larvae prey on aquatic pulmonate snails (Neff and Berg 1966).

Tetanocera ferruginea Fallén.—This was not a common species in the sedges stands, as the adults seemingly preferred habitats

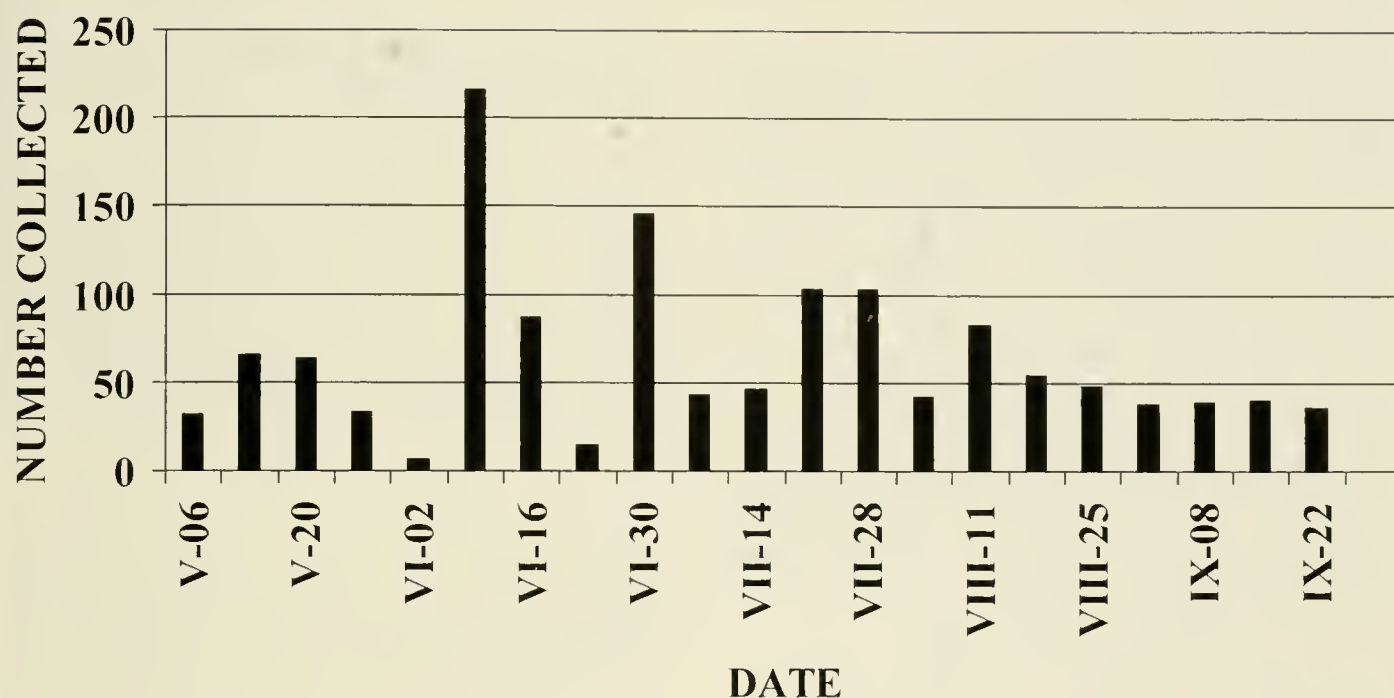


Fig. 4. Seasonal occurrence of individuals of acalyptrate Diptera in *Carex lacustris*.

possessing somewhat deeper water (e.g., cattail marshes). It was multivoltine, producing three or four generations a year. Its larvae feed on a variety of pulmonate aquatic snails (Foote 1999).

Tetanocera loewi Steyskal.—An uncommon species in both *Carex* stands, adults appeared in mid-June, remained at low numbers throughout July and August, and disappeared from the marsh in late September. It had a single generation a year, with overwintering occurring as unhatched first-instar larvae within the egg envelopes. Hatching took place in March, and most of the larval feeding on a variety of pulmonate aquatic snails (*Physa*, *Lymnaea*, *Gyraulus*, *Helisoma*) was completed during April and early May (Foote 1999).

Family Sepsidae

Sepsis flavimana Meigen.—This was the only species of Sepsidae that was taken repeatedly in the sedge stands, and was particularly abundant in *C. stricta*. Its larvae are unselective scavengers of decaying organic matter, particularly dung (Ferrari 1987).

Family Sphaeroceridae

Leptocera fontinalis (Fallén).—This was the only abundant species of the six species

of Sphaeroceridae encountered in the sedge stands, being particularly common in *C. stricta*. Larvae of all species are thought to be scavengers of decaying organic matter (Ferrari 1987).

Family Ulidiidae

Chaetopsis aenea (Wiedemann).—This was a common species in both stands of *Carex*, but showed a distinct preference for *C. lacustris*. It first appeared and reached peak abundance in early June, and largely disappeared by late July. Larvae feed as secondary consumers in stems of monocots that have been damaged by more phytophagous species (Allen and Foote 1992).

Chaetopsis massyla (Walker).—This species was also recorded in both stands, with greatest abundance in *C. lacustris* in late June. Its larvae feed as secondary invaders of stems of damaged wetland plants (Allen and Foote 1992).

OCCURRENCE IN THE TWO STANDS

Carex stricta supported a somewhat greater number of acalyptrate taxa, with some 74 species being recorded. In contrast, 64 species were taken in *C. lacustris* (Table 1). One possible explanation for the slightly greater species richness in *C. stricta*

was the fact that this tussock sedge species has a clumped distribution with open spaces between clumps. This allowed light to reach the marsh floor, resulting in greater algal growth that served as larval food for some species of Ephydriidae. In contrast, *Carex lacustris* is a rhizomatous species that formed a more closed canopy over the marsh substrate. There was considerable sharing of species among the two species of *Carex*, and Sørensen's Similarity Index (Sørensen 1948) was 0.66 meaning that 66% of the acalyptate species were found in both sedges.

SEASONAL OCCURRENCE

The number of species in both of the *Carex* stands peaked in June and remained fairly constant throughout the remainder of the summer (Fig. 1). Many species were found throughout the warm season, but a few species obviously were univoltine or bivoltine. For example, adults of *Epichlorops exilis* peaked in early June (Fig. 2). Adults of *Sepedon tenuicornis* overwintered in the marsh and were quite abundant again in late summer (Fig. 3). Total abundance of adult flies in the two stands peaked in early June (Fig. 4), and populations had largely collapsed by mid-October.

GUILD STRUCTURE

There was obvious partitioning of food resources in the two stands of *Carex*, with eight trophic guilds being recorded (Table 1). The largest guild involved some 23 species that fed as generalized scavengers of decaying organic matter. The phytophagous community consisted of a leaf-mining guild containing six species, a stem-boring guild of eight species, and a seed predator guild of three species. The guild of secondary invaders consisted of 13 species whose larvae fed as scavengers on stem tissues previously macerated by more phytophagous species. An interesting guild consisted of seven species whose larvae consumed Cyanobacteria. The snail predator guild contained 14 species, and three species preyed upon oth-

er insects. The larval feeding habits of 15 species remain unknown.

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